EXHIBIT 2

Report of Joseph V. Rodricks, Ph.D., DABT

In the matter of:

City of New York,
Plaintiff

Case No. 04-Civ-3417

vs.

Amerada Hess Corp., et al.,
Defendants

Prepared by:

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I. PURPOSE OF REPORT AND SUMMARY OF CONCLUSIONS

This report was prepared to address issues raised in the matter: City of New York, Plaintiff, *vs*. Amerada Hess Corp., et al., Defendants, Case No. 04-Civ-3417.

The Clean Air Act Amendments of 1990 required the addition of oxygenates to gasoline for areas of the country with serious problems in achieving the National Ambient Air Quality Standard (NAAQS) for ozone and for the Wintertime Oxygenated Fuel program. Methyl-*tertiary*-butyl ether (MTBE) and, to a lesser extent, ethanol, are oxygenates that have been used to comply with the legally mandated reformulated gasoline (RFG) program. This report offers a comparison of the potential human health risks associated with the use of ethanol and MTBE.

This comparison involves examination of both *direct* and *indirect* human health risks. Direct risks are those associated with human consumption of any drinking water supplies that may have come to contain MTBE or ethanol as a result of their use in gasoline. Indirect risks are those resulting from the effects of oxygenate addition on emissions to air of other chemical substances.

Before addressing health risks of the oxygenates themselves, it is important to recognize that the legally mandated use of oxygenates in gasoline has resulted in significant human health benefits, because they are effective in improving air quality. Part II of the report provides a brief summary of these benefits.

> *Based on all available information regarding the potential direct and indirect health risks of ethanol and MTBE, and on the additional fact that both provide significant benefits to air quality and human health, it is clear that the choice of MTBE as a fuel oxygenate was reasonable and well supported by scientific evidence when the use of oxygenates was first required under the Clean Air Act, and remains reasonable and well-supported today.*

Evaluating health risks begins with a summary of the properties of MTBE, and an assessment of the potential risks to human health that can be scientifically inferred from these properties (Part III of this report).

> *It will be shown in Part III that over the range of MTBE levels in drinking water that people could tolerate aesthetically, and even over a substantially higher range (that people could not drink, because of unacceptable taste and odor), there is no expectation that MTBE will cause harm to human health. This conclusion is based on a substantial body of scientific evidence that was available when the Clean Air Act Amendments first required the use of oxygenates and that still holds today.*

A summary of what is known about the adverse health consequences of ethanol exposure is provided in Part IV.

> *It will be shown in Part IV that, although ethanol intake is associated with many significant adverse human health effects, these effects are unlikely to occur when ethanol is present in ground water as a result of its use in gasoline. Thus, direct human health risks from both MTBE and ethanol are negligible, and on these grounds, both oxygenates were reasonable choices for use in fuels. Other factors – namely potential indirect health risks – are of much greater importance when considering the choice of oxygenates, and this was as true when the law first required use of oxygenates as it is today.*

Indirect risks of ethanol and MTBE are discussed in Section V.[1] Both oxygenates affect the emissions to air (from the tailpipe and from gasoline evaporation) of nitrogen oxides (NO_x), hydrocarbons, acetaldehyde, formaldehyde, benzene, and 1,3-butadiene. All of these substances may pose risks to human health, and benzene is a known cause of human leukemia.

> *It will be shown in Part V that the use of MTBE in gasoline generally results in greater reductions in air emissions of these toxic substances than does the use of ethanol. Based on these factors the choice of MTBE as an oxygenate was entirely reasonable when the law first required use of oxygenates, and remains so today.*

Section VI of the report provides a discussion of the Environmental Protection Agency's historical understanding of MTBE groundwater contamination and toxicology issues.

[1] Other indirect risks of concern relate to the relative effects of ethanol and MTBE on the mobility and degradation of other constituents of gasoline in water, should contamination occur. These topics are not directly within the bounds of my scientific qualifications.

of either the NOAEL or minimum level (Benchmark Dose) needed to produce a detectable excess of tumors or non-cancer effects to New York State's 10 ppb Ambient Water Quality Value (Table 1) are termed the Margins of Safety (MoS). Interpretation of these MoS is discussed in Section III.F.

There is some difficulty in making these comparisons, in that the *units* of MTBE exposure in the animal inhalation studies are different from the units of exposure in the oral (gavage) animal studies, and both are different from the units (ppb, which is weight of MTBE in micrograms (0.000001 g) per one liter of water) in which the odor/taste figures are presented. To make comparisons possible, all of the exposure information from the toxicity studies has been converted to *weights* of MTBE received by the animals; and then these weights have been converted to drinking water concentrations. The weights of MTBE are thus presented as micrograms per liter of water, assuming that people would ingest the standard 2 liters of water each day (Column 2 in Table 1). Not only are these concentrations in Column 2 expressed in the same units, but they are also in the same units as New York State's Ambient Water Quality Value. The MoS (Column 3) are obtained simply by dividing Column 2 figures by 10 ppb. The MoS are described (by example) as follows: at a drinking water concentration of 10 ppb, people consuming 2 liters of water each day for a full lifetime would receive an amount of MTBE 623,000 times less than the minimum amount necessary to produce excess kidney tumors in rats receiving the compound each day for their full lifetimes. These MoS values are analogous to those calculated by USEPA (1997), but using Benchmark Dose Modeling rather than simple NOAELs for non-cancer effects where possible, and using New York State's 10 ppb Ambient Water Quality Value rather than EPA's 20 – 40 ppb Drinking Water Advisory Level as the point of comparison.

Table 1
Estimation of Margins of Safety (MoS) for MTBE at the New York State Ambient Water Quality Value of 10 ppb (μg/Liter)

Form of Toxicity/ Duration of Exposure	NOAEL or $BMDL_{10}$ [a] (μg/Liter)	MoS [b]
Noncancer (less-than-lifetime)		
Kidney	22,900,000 ($BMDL_{10}$) [c]	2,290,000
Neurological	7,400,000 (NOAEL) [d]	740,000
Reproductive/Developmental	20,000,000 - 68,000,000 ($BMDL_{10}$)	≥2,000,000
Cancer (lifetime)		
Rat Lymphoma and Leukemia in females (gavage) [e]	805,000	80,500
Rat Kidney Tumor in males (inhalation)	6,230,000	623,000
Mouse Liver Tumor in females (inhalation)	11,025,000	1,100,000

[a] The $BMDL_{10}$ is the lower 95% statistical confidence bound on the estimate of dose corresponding to a 10% increase in the risk of the form of toxicity indicated.

[b] MoS values have been rounded according to accepted scientific practice.

[c] Assuming a linear relationship between dose and risk.

[d] These data are not amenable to Benchmark Dose Modeling.

[e] Significant questions remain regarding the scientific validity of these findings, as described on p. 15.

F. Interpretation of Margins of Safety for MTBE in Drinking Water

There is a long-standing tradition in toxicology that human exposures to chemical substances should be limited to some fraction of the NOAELs or the minimum levels at which toxic effects are elicited in animals. There are several reasons for such caution. First, there are reasons to believe that humans may be more sensitive to a chemical's toxic effects than are in-bred and well-cared for lab animals, and furthermore, that among humans, some are more sensitive than others. It is well-supported that a factor of 100 (corresponding to an MoS of 100) is adequate to take into account these factors (Dourson et al. 1996). Sometimes, additional factors are introduced to account for other uncertainties. For example, a larger factor is used if there are no experimental NOAELs available, but only minimum effect levels. It is rare for factors to exceed 1,000, although for some chemicals factors up to 3,000 are used (USEPA 2002).

It is my view that, given the uncertainties in the animal carcinogenicity data and the fact that they are probably irrelevant to humans, an MoS in the range of 1,000 to 3,000 is more than adequate to protect human health. It can be seen in Table 1 that the smallest MoS (based on the highly questionable Belpoggi et al. (1995) study – see Attachment B) is 80,500 and that most are well above 100,000.

It is clear that the minimum threshold exposure level for MTBE is hugely in excess of the New York State Ambient Water Quality Value of 10 ppb. Thus, at this level, and even over a substantially higher range (that people could not drink, because of unacceptable taste and odor), there is no expectation that MTBE will cause any type of harm to health.